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Statement On
THE STRATEGIC DEFENSE INITIATIVE

By

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Director
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Before The
Subcommittee On Research And Development
Committee On Armed Services
House Of Representatives

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INTRODUCTION

Mr. Chairman and Members of the Committee, I am pleased to appear before you today to speak in support of the Strategic Defense Initiative (SDI) budget request and to answer any questions you may have about the program.

The SDI program is in its sixth full year of research to determine the feasibility of effective defenses against ballistic missiles, and we continue to make excellent progress across a broad range of technologies. During FY 1989 we conducted a record number of major experiments and tests crucial to program success. We will break that record in FY 1990 and, with your support, surpass it in FY 1991 (Figure 1). The growing number of tests and experiments demonstrates that the program is moving away from paper feasibility studies, laboratory work and infrastructure development which characterized prior years. We are now moving into the testing of hardware, thus capitalizing on SDI investments. I shall discuss some of the more important program developments later in my statement.

FY 1991 PROGRAM BASIS

The FY 1991 SDI budget request submitted to the Congress by the President on 29 January 1990 is structured around the following Presidential guidance:

- Provide for an informed decision on deployment within three years.
- Pursue options for layered defenses, consisting of both space and ground-based elements, which offer the promise of meeting the requirements issued by the Joint Chiefs of Staff (JCS) for Phase I defenses.
- Expedite research and development of promising defense concepts (such as Brilliant Pebbles) that could intercept missiles during the boost portions of their flight. Pursue other Phase I space-based system components as a back up.
- Conduct the program in full compliance with all U.S. international obligations, including the Anti Ballistic Missile (ABM) Treaty.
- Structure the program to permit deployment of layered defenses on a schedule as close as possible to that envisioned

FIGURE 1 MAJOR TECHNICAL ACCOMPLISHMENTS



I would like to take a few minutes to discuss each of these five points in some detail.

PROVIDE FOR AN INFORMED DECISION ON DEPLOYMENT

To support this decision, the FY 1991 SDI program is structured to continue research and development on a broad range of maturing and advanced technologies. Research to demonstrate and validate elements of the Phase I system is balanced with tests and experiments for follow-on concepts such as directed energy technologies. The program is focused on reducing technical risk in areas such as target signatures against a variety of backgrounds, communications, radiation hardening, space power, and system integration. The program is also focused on reducing costs in areas such as optics, focal plane arrays, light weight materials, and launch. The overall approach is intended to provide the decision makers with information on initial defenses and options for future capabilities to enhance initial defenses should this prove necessary.

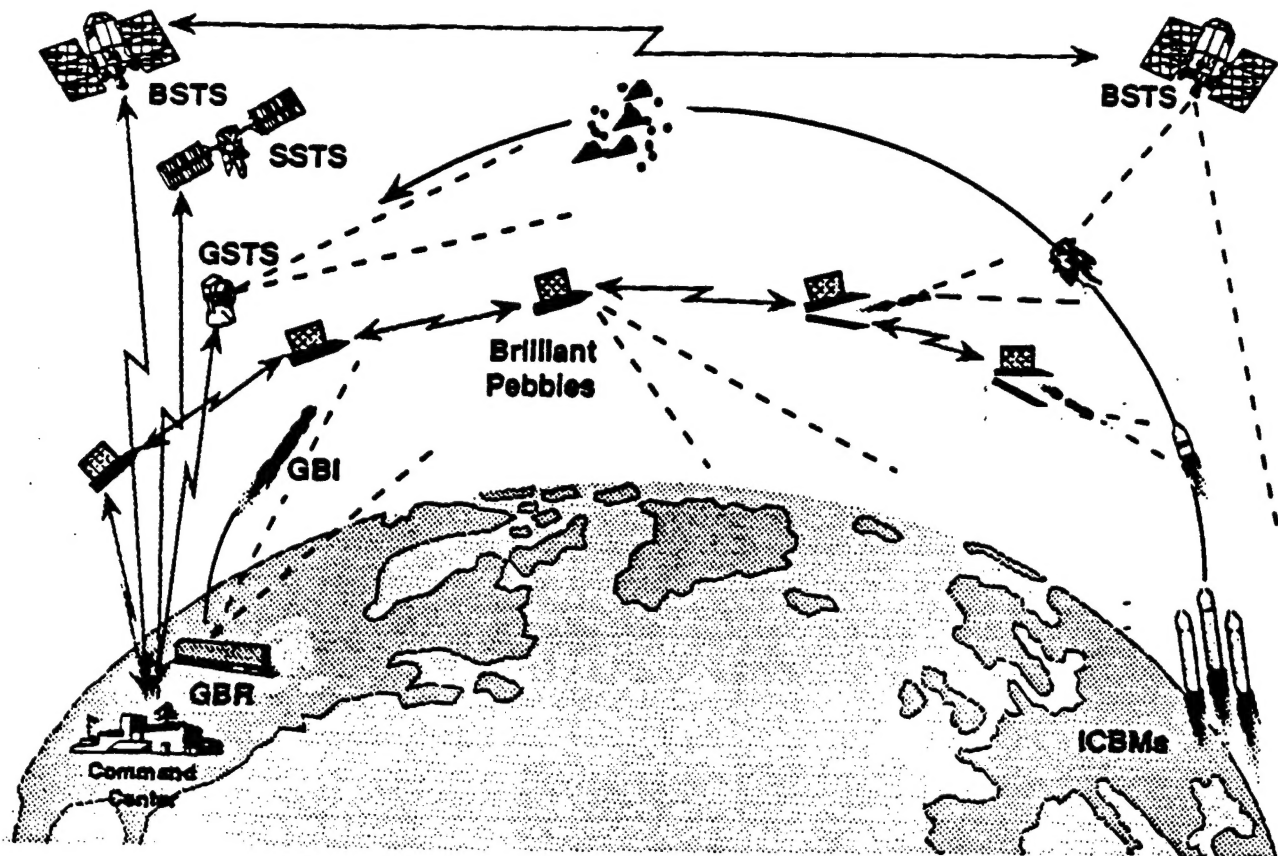
LAYERED DEFENSES TO MEET JCS REQUIREMENTS

The Phase I system has been designed to serve as the first in a potential series of deployments leading to a more balanced deterrent posture based on offensive and defensive forces. With this understanding, the JCS issued in 1987 a formal statement of mission objectives and required system characteristics for Phase I. These requirements provide guidance for establishing the architecture explained in prior budget requests and depicted in Figure 2.

The architecture selected is consistent with the findings and recommendations of the 1984 Fletcher Study on SDI, and subsequent studies have confirmed that it is a sound approach. It is a two-layer system consisting of both ground and spaced-based interceptors and sensors and their supporting systems.

I would also like to review for the Committee the rationale for pursuing layered defenses. As you know, layered defenses are those which engage attacking missiles in more than one portion of their trajectories. The significant benefit to layered defenses is that they are highly effective against a variety of attacks and are less vulnerable to possible countermeasures. The FY 1991 SDI program is consistent with this rationale. First, our research is aimed at space-based kinetic and directed energy weapons and sensors for the high payoff, boost/post boost region where a single hit by a defensive weapon could destroy multiple attacking warheads and their decoys. Second, we are examining ground and space-

**Figure 2
SDS PHASE ONE ARCHITECTURE**



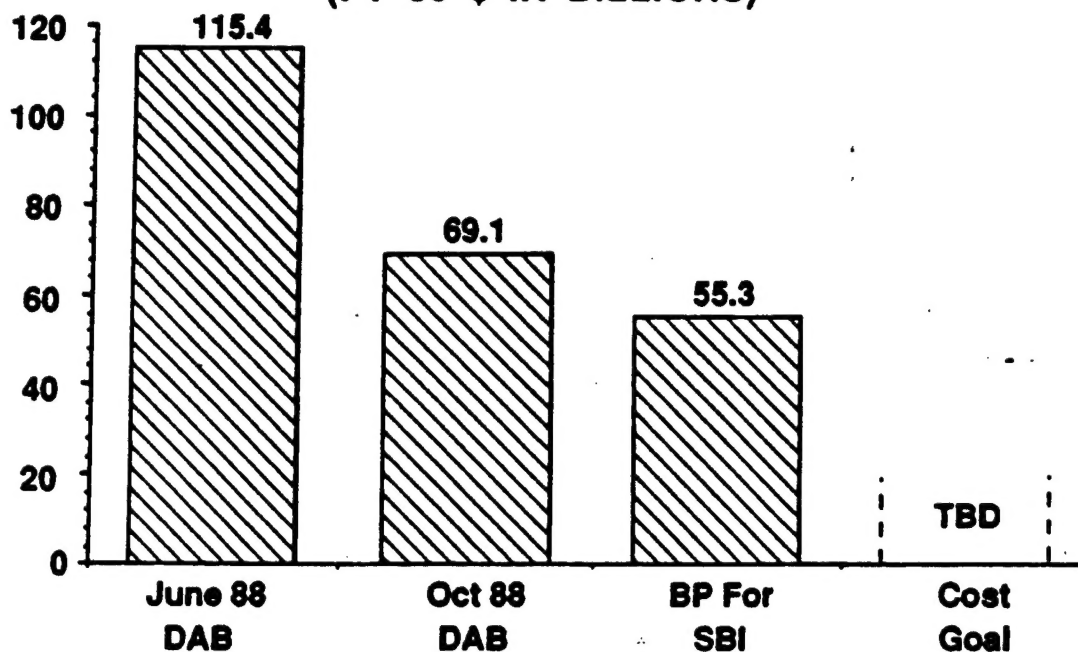
based kinetic and directed energy weapons and sensors to detect and destroy warheads during their relatively long flights in the midcourse region. Additionally, we will explore ways to destroy warheads as they reenter the atmosphere in the terminal region.

EXPEDITE RESEARCH OF PROMISING CONCEPTS (BRILLIANT PEBBLES)

The Brilliant Pebbles concept consists of a light-weight, low-cost, single hit-to-kill kinetic kill vehicle that provides integrated sensors, guidance, control, and battle management. During FY 1989, this autonomous, highly survivable, space-based defensive interceptor concept was independently reviewed by a Department of Defense Space-Based Architecture Study Group, by the distinguished JASONS panel of scientists, and by the Defense Science Board. The concept was found to be

innovative and capable, with no fundamental flaws, and deserving of continued support. Initial cost estimates show that Brilliant Pebbles could reduce the cost of a Phase I system by at least 20% (Figure 3). I believe that these estimates are conservative, especially in light of the opportunities for innovation in manufacturing technology for producing large numbers of identical Pebbles. I also believe that the strategy we have selected for developing this concept will take advantage of these opportunities.

Figure 3
SDS PHASE I COST COMPARISONS
(FY 88 \$ IN BILLIONS)



We launched in FY 1990 a multiple-contractor competition for concept definition. My office, with the cooperation of the Lawrence Livermore National Laboratory, will manage this highly streamlined program. The program is designed to bring industry on board and at the same time maintain the simplicity and low-cost features of the concept. A follow-on design competition will be initiated in FY 1991. To obtain maximum benefit from contractor innovation, we are not imposing military specifications or standards. Requests for proposals and contracts will state requirements in a simple fashion, and contractor reporting requirements will be minimized.

Additionally, given Brilliant Pebbles potential for independent operation, the role of the Boost Surveillance and Tracking System and the Space Surveillance and Tracking System in the Phase I architecture is being reassessed. Although these sensors are definitely needed for non-SDI missions, the Phase I architecture with Brilliant Pebbles may not require

these sensors or may require less capability from them. This outcome could further reduce the cost of a Phase I system.

In line with Presidential guidance and Defense Science Board recommendations, we will continue research and development on more conventional space-based interceptor concepts.

TREATY COMPLIANCE

The Department of Defense has in place an effective compliance process under which the Undersecretary of Defense for Acquisition, in consultation with the Department's General Counsel, Undersecretary of Defense for Policy, and Chairman JCS, ensures that all defense programs are in compliance with all U.S. strategic arms control obligations. SDI experiments, tests, and other research and development efforts proposed for FY 1991 will, prior to execution, be carefully screened by the Department's Compliance Review Group to certify that planned activities fully comply with the ABM Treaty. This compliance process has been followed in all previous years of the SDI program. Additionally, I, as the Director of the SDI program, am required to certify continued compliance quarterly and have established internal procedures to do so.

ATTEMPT TO MAINTAIN JANUARY 1989 PLANNED SCHEDULE

Planned funding for the SDI program for FY 1990 through FY 1994 was reduced substantially after January 1989. The President understood that this could adversely impact our ability to maintain the pace of the program. Yet, he asked that we try. I am pleased to report to this Committee that we have, to a large extent, been successful. We did this by making things simpler and cheaper. Incorporation of advances in technology, the inclusion of Brilliant Pebbles in the space-based segment of the Phase I architecture, and judicious use of available resources has, so far, allowed us to maintain the program balance and pace needed to support a decision on deployment and to maintain an option for initial deployment in this decade. Our ability to continue on this path clearly depends on the level of funding for FY 1991 and beyond.

SDI PROGRAM PROGRESS

When SDI was initiated, this nation's experience with ABM systems was limited primarily to 9 months of operation in the 1970s of the Safeguard ABM system at Grand Forks, North Dakota. The Safeguard system employed nuclear-tipped missiles and large ground-based radars. Because of technology limitations in areas such as computer guidance, sensors, optics, and miniaturization, we could then not achieve the accuracy needed to realize direct hit-to-kill, which eliminates the need for a

warhead of any kind. We also knew there were important issues with system survivability and battle management. When Safeguard was abandoned, few predicted the large and rapid advances in technology that have permitted ballistic missile defenses to re-enter our national security equation.

Times Have Changed

- In 1984 we hit a "bullet with a non-nuclear bullet" using a ground-based interceptor and on-board passive infrared sensor for terminal guidance to destroy a simulated reentry vehicle launched from a ballistic missile.
- In 1986 we validated guidance laws in space by destroying a thrusting target. This simulated an intercept in the boost portion of a ballistic missile's trajectory.
- In 1987 the Flexible Lightweight Agile Guided Experiment demonstrated that a reentry vehicle could be intercepted in the atmosphere using a radar-guided interceptor.
- In January of 1990 the first High Endoatmospheric Defense Interceptor flight test demonstrated our ability to effectively cool a terminal interceptor's forebody and sensor window. This is a crucial step toward demonstrating that the sensors will not be disabled by heat from atmospheric friction. Until this flight test, many in the technical community believed that effective window cooling could not be achieved.

To intercept a missile or reentry vehicle, defenses first must detect, discriminate, acquire, and track the targets under a variety of conditions. Early in SDI we established, and we continue to operate, a broad-based program to collect target signatures. This program includes numerous sounding rockets and rocket-launched satellites to put up sensors to view targets and decoys against different earth and space backgrounds. It also includes various airborne, shipborne, and ground-based sensors to collect signature data. (Examples of airborne platforms are an NC-135A equipped with sensors that operate in the visible through long wavelength infrared bands and a Lear jet equipped with ultraviolet through medium wavelength infrared sensors.) Further, we have an aggressive program to explore and develop passive, active, and interactive discrimination technology. This program is supported by activities which build and test various decoys and penetration aids to see what will "stress" the system. Some specifics will illustrate our accomplishments in these areas.

- Throughout the 1980s our Delta 180 series detected, acquired, and tracked numerous targets including boosters, reentry vehicles, and decoys.
- In 1988 we collected our first infrared data on foreign targets in the QUEEN MATCH flight, and conducted many sounding rocket tests to evaluate decoys, countermeasures, and the effectiveness of discrimination.
- In 1989, in the JANUS experiment, we used high resolution infrared imagery to collect target signatures of post-boost vehicles.
- Also in 1989, with our space-based interceptor hover test, we integrated a host of technologies and demonstrated the full capability to acquire and track a rocket plume, then transition to tracking the rocket hard body. This capability is absolutely essential for boost and post-boost intercepts.
- In 1990 we will demonstrate that we can detect boosting targets of all intensities of interest against a variety of earth backgrounds.

Much progress has also been made in ensuring that defenses can be integrated and managed, always with man-in-the-loop, and that they are survivable.

- The National Test Bed has been established to develop, test and validate strategic defense concepts and software.
- We are building high-fidelity end-to-end simulations that allow defense concepts to be tested against a variety of realistic threat models. This effort provides early user involvement in the development of command and control concepts.
- An early version of a command center was successfully demonstrated at the Army Research Center. This program showed that, with man-in-the-loop, there is sufficient time to assess, react and engage attacking missiles throughout the battlespace.
- We have established a software center of excellence to address the large scale integration of software for a defensive system.
- To ensure that systems can operate reliably in the adverse environments caused by nuclear weapon detonation, we

validate the survivability of system components, such as electronics, optics and structures, through experiments on underground nuclear tests.

- Red/Blue team analyses are conducted to examine the ways in which an attacker may try to defeat the defenses, and to establish effective measures to offset those attempts. Results are then fed back into efforts to design both the system and its operational concepts.

Most of the progress discussed so far relates to Phase I. However, progress in advanced technologies, such as directed energy, has also been impressive. The key issues being examined are target acquisition, pointing and tracking, generation of high power lasers and particle beams, and beam lethality.

- In 1985 we demonstrated at low power the capability to both track a rocket in space and to propagate a laser beam through the atmosphere without significant distortion. In several other experiments, we proved lasers are lethal weapons for destroying both solid and liquid propellant missiles.
- In 1986 our first particle beam experiment irradiated a miniature reentry vehicle with a high intensity proton beam. The results indicated that the explosives contained in a reentry vehicle are detonated by such beams.
- Early in the program many experts had stated that building large optics would be impossible and prohibitively expensive. In 1988 we built a high quality mirror, the first large diameter segmented mirror with a surface that is controlled electronically. That mirror will be integrated into a ground test in 1991.
- In 1989 the Alpha Chemical laser for the first time produced a high-power beam when fired in its ground test facility. This milestone in the space-based, chemical laser program is being used to validate the technology, computational methods, and fabrication processes necessary for scaling chemical lasers, configured for space basing, to power levels required for a strategic defense.
- In 1989 our Beam Experiment Aboard Rocket conducted the first test in space of a neutral particle beam. It employed a relatively light-weight power supply which can be packaged for space operation. It demonstrated that complex directed energy weapons could be reliably operated in space.

- In February of 1990 we launched the first long-term directed energy space experiments from Cape Canaveral. The 2-1/2 year Low-Power Atmospheric Compensation Experiment, known as LACE, will measure the atmospheric distorting effects on laser beams. The 1 year Relay Mirror Experiment, known as RME, will demonstrate the relay element of a ground-based laser.
- The Talon-Gold ground test demonstrated our ability to place a beam on target very accurately. The next challenge is to do it in space, an experiment currently planned for 1992. The precision we are demonstrating in these experiments is equivalent to firing a laser from high above the Empire State building to hit a volleyball on a California beach.

Our research into defense systems has also yielded tremendous technical progress in areas such as miniaturization, reduced manufacturing cost, and light weight structures.

- Efforts in navigation technology have ushered in a whole new class of miniaturized inertial measurement units for navigation and guidance in the 1990s. Bulky units that weighed tens of pounds in the past will weigh only ounces in the future, with costs reduced by a factor of ten.
- We are learning how to manufacture large quantities of infrared detector elements, known as pixels, at greatly reduced costs. Prior to SDI, the costs of such pixels were in the range of hundreds of dollars each. Today we are looking at a range of a few dollars to a fraction of a dollar.
- Our work on making stiff, high-performance trusses and tubes from advanced composite materials provides one example of developing lightweight, high strength structures for space platforms.

These and other advances have been exploited to reduce the costs and enhance the performance of prospective strategic defense systems.

Additionally, our research has yielded a wealth of spin-off applications of SDI technology.

- An outgrowth of our free electron laser program is medical use of lasers to remove burn and scar tissue, break up kidney stones, and treat heart disease and cancer.

- Some of our laser work also contributed to a blood bank purification process that cleanses donor blood bank supplies of infectious viruses.
- SDI-developed carbon material for use in orthotic braces will double the strength and reduce the weight by two-thirds when compared to conventional steel braces.
- Our work on optical technologies could lead to a new generation of very high speed, low cost supercomputers.
- SDI neutral particle beam technology may have applications in areas such as airport detection of explosives, cancer therapy, and non-destructive inspection of manufactured items such as rocket motor components.
- SDI research is creating commercial opportunities in superconductivity, diamond crystal coatings, communications, industrial manufacturing processes, electronics, and microwave technology.
- SDI hypervelocity gun technology may be utilized for mass transfer of materials from the lunar surface to low earth orbit.
- The National Aeronautics and Space Administration's Space Station and National Aerospace Plane should benefit from SDI advances in computing, signal processing, and light weight structures.
- SDI technology may have other defense uses such as reducing the weight and cost of air-to-air missiles. Hypervelocity gun and directed energy technology could also be used in the theater battlefield.

As you can see, Mr. Chairman, SDI technical progress during the 1980s has been very impressive across a broad range of technologies.

FY 1991 BUDGET AND PROGRAM HIGHLIGHTS

I will turn now to the highlights of our FY 1991 budget and program. The Fiscal Year 1991 budget request for the SDI program is \$4.47 billion. Although this is an increase of \$870 million over the FY 1990 appropriation, it is a \$1.0 billion reduction from the FY 1991 budget included in the FY 1990/1991 budget request last year. Our major technical plans are discussed next.

Development of the Boost Surveillance and Tracking System (BSTS) missile launch warning satellite is on track. The system is scheduled to enter full-scale engineering development in FY 1991, subject to a successful ground demonstration in FY 1990. BSTS is essential to the national mission of tactical warning/attack assessment and other missions. However, its role as a critical node to strategic defense has diminished with the adoption of Brilliant Pebbles. The first launch of a full-scale development vehicle is planned for the mid-1990s.

The High Endoatmospheric Defense Interceptor is the most advanced concept being considered for terminal defense. It is a ground-based, hypervelocity, high acceleration interceptor designed to destroy ballistic missile reentry vehicles high in the atmosphere. It is both a potential follow-on to Phase I and a back up to the Ground-Based Interceptor. The High Endoatmospheric Defense Interceptor also has strong potential for theater defense. During the remainder of FY 1990 and in FY 1991 we will prepare to conduct a second flight test to verify target acquisition and tracking functions, control and guidance systems, and seeker window survivability.

In FY 1991 we will also continue construction of the technical facilities for the Free Electron Laser Accelerator, Wiggler, and Beam Control System at White Sands Missile Range in New Mexico. When completed (in approximately FY 1993), it will be available to house the high power laser required to conduct the technology integration experiments needed to validate the concept.

As I mentioned previously, during FY 1991 we plan to conduct a record number of major tests and experiments (16). These will encompass a broad range of technologies, and they include:

- The first intercept by a Brilliant Pebbles experimental vehicle;
- Major phenomenology experiments to collect vital signature and environmental data in support of the target acquisition, tracking, and discrimination functions;
- A pulsed high power concept demonstration of a free electron laser device;
- A full power test of the neutral particle beam ground test accelerator at Los Alamos; and

- The first flight tests of the Arrow theater defense experimental interceptor. Arrow is a good example of an allied cooperative program.

THEATER DEFENSE AND OUR ALLIES

Mr Chairman, before concluding, there are two other important topics related to the SDI program that I would like to address. These topics are theater defense and the participation of our allies in the SDI program.

The SDI charter reflects a concern for both U.S. and Allied security and stresses development of defensive technologies for ballistic missile threats of all ranges. The FY 1991 program would continue our theater defense program that includes examination of architecture studies, technology demonstrations, tests, and the development of test beds to explore alternatives which could provide a defense against theater-class ballistic missiles. Allied participation has enhanced our understanding of theater defense problems.

In fact, Allied participation in theater defense and other SDI research has proven beneficial to both the SDI program and to our Allies. We have also recently signed several cost-sharing, project-specific cooperative research commitments with the Allies. Allied participation contributes to the attainment of SDI objectives, and we will continue to cooperate with our Allies on many aspects of the SDI research program.

CONCLUSION

In conclusion Mr. Chairman, I believe that the most significant evidence of progress during the six year history of the SDI program is that we now have:

A Phase I architecture that will meet the requirements for strategic defense, based on technically achievable sensors, command and control capability, and interceptors;

Reasonable cost projections for such a system;

A set of technology development projects that support Phase I as well as follow-on systems that could employ advanced concepts such as lasers and neutral particle beams; and

A national strategic defense research and development infrastructure, staffed with extremely talented and dedicated professionals, that stands ready to resolve the remaining technical and engineering issues of strategic defenses.

A team of experts from the prestigious American Institute of Aeronautics and Astronautics Society spent a year looking at our program. This was the first group to review our entire program, including Phase I, follow-on systems, and our technology efforts. They said, "no fundamental obstacles were found." Deployment of a Phase I system depends on the resolution of technical issues currently being addressed. The engineering task remaining is challenging, but it can be accomplished.

SDI research is an excellent investment. That is why, in an era of scarce defense resources, the President is so supportive of the program. We continue to show impressive results. You can be assured that significant technological advances which occur in the future will be exploited to further reduce the cost and improve the performance of a prospective strategic defense system. Our past record amply supports this commitment.

Mr. Chairman, I believe that in the first six years of the SDI program we have demonstrated that our capability to develop and deploy effective defenses is constrained not by our ability to overcome technical hurdles, but by the funding we receive. I therefore urge you and the Members of the Committee to support our full budget request. With your backing, we can continue a balanced and vigorous program of research and development leading to deployment of strategic defenses for our nation.

I will be happy to answer any questions you may have.